Assignment for Workshop Participants
SSL R&D Tasks and Subtasks for Review
Group 1. Inorganic SSL "Core Technology" Research

On the second day of the 2005 DOE Solid-State Lighting Program Planning Workshop, participants will be asked to review, update, and prioritize the Department's SSL R&D agenda. To facilitate that process, the Department is asking participants to **review and comment on the tasks and subtasks that are pertinent to your area of interest**. The tasks and subtasks are grouped into four topic areas:

Group 1. Inorganic SSL "Core Technology" Research
Group 2. Inorganic SSL "Product Development"
Group 3. Organic SSL "Core Technology" Research
Group 4. Organic SSL "Product Development"

The Department defines Core Technology and Product Development as follows:

Core Technology - Core Technology research includes scientific efforts that seek to gain more comprehensive knowledge or understanding of the subject under study, with possible multiple applications or fields of use in mind. Within Core Technology research areas, scientific principles are demonstrated, and the knowledge is shown to offer price or performance advantages over previously available science/engineering. Laboratory testing and/or math modeling may be conducted to gain new knowledge, and provide the options (technical pathways) to a SSL application. Activities could include theory, fabrication, and measurement of a material to provide the detailed understanding (properties and relationships) that solve one or more of the technical challenges of the DOE SSL program. Tasks in Core Technology are truly innovative and groundbreaking, fill technology gaps, provide enabling knowledge or data, and represent a significant advancement in the SSL knowledge base. These tasks focus on gaining pre-competitive knowledge for future application to products, for use by other organizations. The desired outcome is pioneering work that would be available to the community at large, to use and benefit from as they work collectively towards attainment of the DOE's efficacy goals.

Some examples: theoretical investigations of light generation and extraction at molecular scales; material properties of substrates, encapsulants, or polymers; software tools that capture scientific principles to expedite the decision process of design; modeling of heat transfer principles to estimate temperature profiles within a semiconductor reactor; and mapping of scientific principles that explain the interactions of dopants and hosts or metal alloys to create light of a specified spectrum.

Product Development - Product Development is the systematic use of knowledge gained from basic and applied research to develop or improve commercially viable materials, devices, or systems. Technical activities are focused on a targeted market application with fully defined price, efficacy, and other performance parameters necessary for

success of the proposed product. Product development encompasses the technical activities of product concept modeling through to the development of test models and field ready prototypes. In some cases, product development may include "focused-short-term" applied research, but its relevance to a specific product must be clearly identified.

Laboratory performance testing is conducted on prototypes to evaluate product utility, market, legal, health, and safety issues. Feedback from the owner/operator and technical data gathered from testing are used to improve prototype designs. Further design modifications and re-testing are performed as needed.

Along with the technical aspects of product development, market and fiscal studies are completed to ensure a successful transition from product development to demonstration and commercialization. To be positioned for success, new products must exhibit cost and/or performance advantages over commercially available technologies.

Assignment for Workshop Participants

Within each of the four grouped topic areas, the Department's SSL R&D agenda is further broken down by tasks and subtasks. At the workshop, participants will discuss and vote on each of the tasks and subtasks. In this assignment, workshop participants are asked to **answer the following three questions when reviewing all the tasks and subtasks within Group 1: Inorganic SSL "Core Technology" Research.** Please provide written responses with your answers and comments to DOE.SSL.Updates@ee.doe.gov by January 14th, 2005.

Question 1: Do you agree with each task and subtask as written? If not, provide a proposed rewording, using the same outline format.

Question 2: Which, if any, subtask(s) require detailed discussion at the workshop? Please identify which one(s) and provide an explanation.

Question 3: Is this list complete? If not, please identify any Task or Subtask that is missing, using the same outline form, and provide an explanation.

The input you provide on the tasks and subtasks in your area of interest will help to identify common threads, disconnects, or oversights prior to the workshop, and focus the discussion on Day 2. The subsequent voting will directly affect the development of need statements for future DOE SSL solicitations.

Group 1. Inorganic SSL "Core Technology" Research

1.1 Inorganic Materials Research: Enabling Physics and Chemistry

Goal: increase internal quantum efficiency

1.1.1 Substrates, buffer layers, and wafer research
- Large area, low defect density bulk substrates
- Low defect density buffer layers

1.1.2 High efficiency visible and near-UV semiconductor materials
- Efficient, yellow-green emitters
- Efficient near UV emitters (360 to 410 nm)
- P-doping and charge mobility studies

1.1.3 Reliability and defect physics for improved LED lifetime
- Device, dopant and defect physics and interactions
- Dopant and defect characterization
- Droop (reduced efficiency at high temperature and current density)

1.2 Inorganic Device Architecture and Conversion Materials

Goal: increase external quantum efficiency

1.2.1 Source emitters
- Lasers, resonant cavities
- Photonic crystals & microcavity effects
- Surface plasmons

1.2.2 Stable, efficient, long-life phosphors, luminescent materials for wavelength conversion.
- D65 or spectrum replacing
- High temperature (>200°C)

1.2.3 High temperature, long lived, UV-tolerant encapsulants
- Nanocomposites
- High temperature (>200°C)

1.3 Inorganic Technology Integration

Goal: develop technology that enables high performance devices

1.3.1 Physical, chemical, and optical models for the epitaxial process and the LED device

1.4 Tools and Techniques to Improve Inorganic Manufacturing

Goal: cross-cutting improvements to manufacturing

1.4.1 Invention, design and development of in-situ diagnostic tools for the epitaxial process

1.4.2 Modeling and development of low-cost, high-efficiency reactor designs for efficient source utilization

1.4.3 Investigation (theoretical and experimental) of die separation, chip shaping, and wafer bonding techniques

1.4.4 Scale to larger wafers

Total for Group 1. Inorganic SSL "Core Technology" Research: 4 tasks and 11 subtasks.